

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Comment: CFC-11 is still
used for Space Shuttle
foam application - continue
to provide exemption

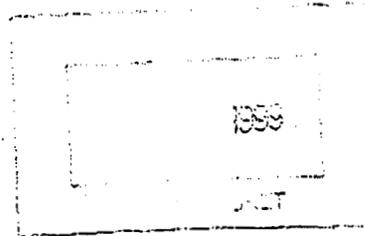


AUG 12 1999

Reply to Attn of:

JE

Environmental Protection Agency
Public Docket No. A-98-31
Waterside Mall (Ground Floor)
401 M Street, SW
Washington, DC 20460



Ref: Proposed Rule: Protection of Stratospheric Ozone: Reconsideration of the 610 Nonessential Products Ban; as published in the Federal Register, Vol. 64, June 14, 1999; pp. 31772 - 31780.

The National Aeronautics and Space Administration (NASA) appreciates the opportunity to review and comment to the Environmental Protection Agency (EPA) on the referenced proposed rulemaking. NASA believes that participation in the rulemaking process is of vital importance in order to achieve reasonable and effective environmental regulations.

NASA's comments on the proposed rule are presented in the attached document. The proposed restrictions on chlorofluorocarbon (CFC) use will have a direct impact to essential and critical applications of the Space Shuttle Program. Specifically, it will prevent the use of BX-250, a foam which is part of the thermal protection system of the Space Shuttle External Tank (ET), and which utilizes CFC-11 as a blowing agent. Although extensive efforts have been made and continue to be made to replace this material, no viable alternative has been identified. An explanation of the rigorous development/testing and technical requirements of ET foam materials is summarized in the attached comments.

NASA requests that the EPA revise the proposed rule to provide for the use of CFC-blown foam products in applications associated with space vehicles. A significant precedent for treating space vehicles as a unique category may be found in the National Emission Standards for Aerospace Manufacturing and Rework Facilities [40 CFR Part 63, Subpart GG]. This regulation defines space vehicles at 40 CFR 63.742.

Therefore, NASA recommends that the following underscored language be added to the proposed EPA modification of 40 CFR 82.66 (c):

(c) Any plastic foam product which is manufactured with or contains a Class I substance, except for those foam products manufactured with or containing Class I substances that are used in applications associated with space vehicles as defined in 40 CFR 63.742.

The ability of NASA to use CFC-blown foams is needed to ensure the safety and continued success of the Space Shuttle Program.

If NASA can be of further assistance, please contact Mr. Paul Goozh at 202-358-1414, or Ms. Maria Bayon at 202-358-1092.



Olga M. Dominguez
Director
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Enclosure

cc:

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MSFC/MP01/Mr. McCool
MSFC/MP31/Mr. Counts
MAF/MSS3160/Ms. Jordan
USBI/Ms. Murphree

NASA Comments on EPA Proposed Rule,
Protection of the Ozone: Reconsideration of the 610 Nonessential Products Ban,
64 FR 31772

**Request for Essential Use Designation for Class I Foam Blowing Agents in
Space Vehicle Operations**

Introduction

In 1990 the amendments to the Clean Air Act prohibited the offer, sale, or distribution in interstate commerce of "nonessential" consumer products containing Ozone Depleting Chemicals (ODCs), with EPA rules as the mechanism for banning such products. In 1993 EPA banned the use of Class I ODCs in production of packaging foam and other materials, designating such uses as "nonessential uses" of ODCs because alternatives were already available. On June 14, 1999, EPA proposed broadening this ban [64 FR 31772], citing "new and compelling information...that indicates that some sectors continue to use Class I substances in products where the use of the substance today should be considered a nonessential use of Class I substances in a product". Criteria for the nonessential use designation include the purpose or intended use of the product, technological availability of substitutes, safety and health. The purpose of this formal comment is to demonstrate to EPA that there are certain uses of Class I substances that remain essential, and to request an exemption from the proposed rule for "space vehicles", as they are defined in 40 CFR 63.742. One such essential use is in the production of BX-250, a foam that uses CFC-11 as a blowing agent, which is a critical component of the Space Shuttle system and for which no viable substitute has been identified.

Purpose/Intended Use of the Product and Availability of Substitutes For over three decades the United States has led the world in the exploration and use of outer space. Access to and use of space are central for preserving peace and protecting U.S. national security as well as civil and commercial interests. The United States developed the Space Shuttle system to support these efforts by improving its manned access to space. The Shuttle is the first and only reusable space vehicle, and is the world's most reliable and versatile launch system.

The External Tank (ET) is the largest element of the Space Shuttle system. It has two major roles: to contain and deliver liquid propellants to the Space Shuttle Main Engines, and to serve as the structural backbone for the attachment of the Orbiter and Solid Rocket Boosters. A thermal protection system (TPS) is required for the Space Shuttle ET to maintain the quality of the cryogenic propellants, provide protection from aerothermal and Solid Rocket Booster plume heating environments, and prevent formation of ice on the exterior of the tank. The TPS materials must remain intact throughout the Shuttle flight to prevent damage or loss of critical Orbiter tiles and windshields.

The ET TPS consists of four different types of low density polyurethane and polyurethane - modified isocyanurate foams that, for most applications, are sprayed on the tank. These foam materials contain a chemical blowing agent to provide the critical insulation and cell structure properties of the foam. Until recently, all ET foams were blown with CFC-11, a Class I ODC, as

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the blowing agent. Three of the foams have been reformulated to use HCFC-141b as a blowing agent, but efforts have been unsuccessful to reformulate a special application foam, BX-250.

NASA has been very proactive in pursuing alternatives for CFC-11 blown foam in order to comply with the 1990 Clean Air Act Amendments and the 1992 Montreal Protocol, which called for the production phase out of Class I ODCs, including CFC-11. A replacement blowing agent investigation was initiated in 1988 in preparation for the phase out. This investigation, which was completed in 1991, identified HCFC-141b as the best alternative blowing agent being proposed by manufacturers of fluorocarbons and polyurethanes, that was both commercially available and that did not require major changes to the chemistry of existing foams or major modifications to the foam application process.

Human space flight safety is of paramount importance to NASA. Prior to implementation of a new material on the External Tank and Shuttle system, the material must undergo a rigorous development and qualification program. In the case of blowing agent replacement, the development phase consists of performing material property testing of foam formulations using a new blowing agent to determine ET use feasibility. The following criteria were determined for assessing critical properties of replacement candidates:

1. Cryogenic strain capability at -423 degrees Fahrenheit with aluminum under Shuttle flight loads
2. Maintenance of material properties (tensile strength, bond adhesion, etc) over a temperature range of -423 to +300 degrees Fahrenheit
3. Acceptable material recession rate when exposed to aerothermal and radiant heating environment experienced during the Shuttle mission
4. Density and thermal conductivity comparable to the present foam systems to maintain or decrease weight and thickness
5. Processability within the current ET manufacturing facility
6. Resists re-entry heating to maintain an ET debris footprint over an isolated ocean area, protecting the population and established shipping lanes

The blowing agent used in a replacement foam material can significantly affect any one or all of these properties, so an extensive amount of development and qualification testing must be performed to ensure that the replacement material meets all of the requirements. It is also important to note that a foam meeting ET requirements is not typical of the foam industry which mainly provides foam materials for furniture or insulation uses not subjected to the extreme environments encountered during space flight. These requirements are the reason that when no foam substitute exists for ET applications, NASA, as the only industry customer, must formulate a unique substitute.

Material property testing consists of wind tunnel, cryogenic, hot gas, tensile strength, density, and thermal conductivity. Development is usually an iterative process involving several candidates and reformulation to either target or reject alternate materials. The qualification testing phase is a longer, more involved phase that is conducted on selected alternates. This phase expands testing of the alternate to include processing variations, lot-to-lot variability, shelf life, manufacturing capability, and design verification testing using various lots of material.

Upon successful completion, the alternate foam material must be validated in the ET manufacturing process in order to be implemented. This entire process was completed in eight years for the qualified replacement foams containing HCFC-141b as the blowing agent.

After working through a number of processing issues, implementation of HCFC-141b foams in the majority of the ET TPS applications was underway in 1996. However, the results have involved significant unanticipated processing difficulties with increased labor hours for application, and a reduction in damage tolerance due to lower compressive strength. Implementation of the new material has also been plagued by an in-flight phenomenon called "popcorning" resulting in foam loss in certain areas due to a combination of reduced material tensile strength and combined flight environments. This foam loss has caused damage to the Orbiter's insulating tiles that are essential to protect the Orbiter crew against re-entry heating.

In certain applications the replacement foams have not yet been successfully implemented, requiring the continued use of the CFC-11 blown foam (from stockpiled supplies manufactured prior to the production phase out). BX-250 is manufactured in the United States by Stepan and is used solely by the Shuttle program. CFC-11 is also the only back-up material available for the HCFC-141b foam systems in use.

Safety and Health

BX-250 is comprised of a two part A and B "kit" that is mixed at the time of application. CFC-11 accounts for 28% by weight of only the "B" component. It is a closed cell material, so that the blowing agent is trapped in the foams until the External Tank is jettisoned from the Shuttle. At that time, the tank breaks up and is destroyed upon entering the Earth's atmosphere. Although it has an Ozone Depletion Potential (ODP) of 1.0, CFC-11 is not flammable and has a high OSHA permissible exposure limit of 1,000 ppm. The identification and use of replacement foams using HCFC-141b as the blowing agent has reduced the consumption of CFC-11 to a great extent. BX-250 usage in 1998 resulted in the consumption of approximately 4,000 lbs of CFC-11, with future usage anticipated to be roughly the same. In comparison, HCFC-141b usage is approximately 50,000 pounds per year.

Summary

Significant effort and resources have been expended over more than ten years to implement environmentally preferable replacement materials without impacting flight safety and schedules. NASA is keenly aware that there is a finite supply of CFC-11. Work continues on the development of insulating foams using third generation blowing agents with lower ODPs, but at this time there are no replacements available for BX-250, even for qualification testing. Banning all foam uses and losing the ability to purchase BX-250 would have an immediate and direct negative impact on NASA programs not intended by the Clean Air Act. Therefore, NASA hereby requests that EPA continue to consider as essential the use of Class I foam blowing agents in activities associated with space vehicles. This would allow the Space Shuttle program to continue purchasing and using CFC-11 blown foam until viable alternatives are identified and implemented, and will assure the continued safe and reliable operation of the Space Shuttle.